Chapter 6

Learning Styles and Academic Outcomes: A Longitudinal Study on the Impact of a Problem-based Learning Curriculum

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Abstract Learning styles are the preferred ways individuals have for processing knowledge. Problem-based Learning (PBL) might be perceived to suit the 'active' learner because of the brainstorming and group work involved. However, PBL is also intended for those who prefer to learn by researching the literature, those who seek to explore complex questions, and those who like to problem solve and apply knowledge to practice. This study profiled the learning styles of 30 speech and language therapy students in an undergraduate PBL curriculum using the Learning Styles Questionnaire (Honey & Mumford, 2000) and measured their styles repeatedly over a three-year period. The results indicated that students entered the course with a range of learning styles, although in general were not characterized as active learners. Following three years of PBL-based education, the students became significantly more active, although as a group remained largely reflective. Learning styles had both negative and positive associations with academic outcomes in a variety of courses over the three years. The implications for PBL and education are discussed.

6.1 Introduction

The observation that students vary widely in how they learn and process information has encouraged educators to strive to improve learning experiences. This has led to the development of a variety of teaching methods, moving from lecture-based, didactic teaching to more hands-on, practical based methods and, in more recent times, towards self-directed learning. In the early 1970s, David Kolb, at that time a teacher of management students, started to experiment with alternative teaching methods to the traditional lecture. He became aware that students had individual preferences for how they approached learning, or 'learning styles', which are "the composite of characteristic cognitive, affective, and psychological factors that serve as an indicator of how an individual interacts with and responds to the learning environment" (Duff & Duffy, 2002, p. 148). Learning styles have sometimes been described in terms of the social situations in which people prefer to learn (alone or with peers); the learning environment (silence or background noise); or the depth of learning achieved ('surface', 'deep' or 'achieving') (Biggs, 1987b). Others have described an individual's learning style as the attitudes and behaviours that determine their preferred way of learning (Honey & Mumford, 1992).

A number of models of learning are associated with theories of learning styles. Kolb's theory of experiential learning is one of the more influential models. In this theory, "knowledge results from the combination of grasping and transforming experience" (Kolb, 1984, p.41). He proposed four stages of learning, beginning with 'concrete experiences', which form the basis for the next stage of 'reflective observations'. The learner then transforms the information into 'abstract concepts' before finally 'actively experimenting' with the ideas drawn. Kolb argued that learning is not complete until all stages of the cycle have been processed, and that they must be followed in sequence (Fig. 6.1). However, he acknowledged that individual learners prefer to begin the cycle at different stages. For example, some prefer to actively engage with an experience before reflecting on it, while others prefer to explore abstract concepts theoretically before experimenting with them in practice (Kolb, Boyzantis, & Mainemelis, 2000). These individual preferences were characterised into Kolb's four dominant learning styles: 'diverging', 'assimilating', 'converging' or 'accommodating'. Kolb maintained that developing an awareness of one's learning style is a prerequisite to becoming a better all-round learner (Coffield, Moseley,

Hall, & Ecclestone, 2004), and so devised the Learning Styles Inventory (LSI; Kolb, 1976), to help learners identify their styles.

Kolb's theory and inventory led to a large body of research in the area of experiential learning. Honey and Mumford (1992) credit Kolb for his theory which underlies their own model of learning styles, although they devised their own inventory, the Learning Styles Questionnaire (LSQ; Honey & Mumford, 2000), to identify these styles. This was because they found the LSI to have low face validity; they claimed that the LSQ had higher validity as the statements refer directly to behaviours, attitudes and preferences (Klein, McCall, Austin, & Piterman, 2007). The LSQ contains 80 statements that probe behaviours aligned with four main learning styles; 'reflectors', 'activists' theorists' and 'pragmatists'. Activists are said to prefer active experimentation, trying things out and thinking on their feet, while reflectors prefer reflective observation, researching and considering all perspectives before acting. Theorists like to draw conclusions based on abstract conceptualisation and complex theoretical constructs and pragmatists are essentially practical, preferring to implement actions based on concrete experiences (Coffield et al., 2004). Examples of statements in the LSQ that apply to each learning style are:

- *Reflector*: I like to reach a decision carefully after weighing up many alternatives
- *Activist:* In discussions, I usually produce lots of spontaneous ideas
- *Theorist:* I am keen to reach answers via a logical approach
- *Pragmatist:* I am keen to try things out to see if they work in practice

Honey and Mumford aligned their four learning styles with the four stages of Kolb's learning cycle and maintain that learners should become proficient in all four stages of the learning cycle, so that they review experiences, learn lessons and plan improvements. Honey (2002) also argued that individuals could enter the learning cycle at any stage depending on whether they want to reflect on information, test a hypothesis or implement information to see how it works in the real world.

Unfortunately, learning styles theory has yet to have a strong empirical basis. Coffield and colleagues (2004) conducted a systematic review to investigate the impact of learning style theory on teaching and learning and found it to be an extensively studied but opaque, contradictory and controversial area. Overall, they identified very few robust studies that offered reliable and valid evidence for many learning style inventories, and there were few studies that provided clear implications for teaching. The review noted that Kolb's LSI had low psychometric properties. In addition, the review noted contradictory outcomes from studies considering the fit between Kolb's learning styles and teaching methods. Although some studies found that using the LSI was effective (Shaywitz et al., 1995) others found that it made no difference to the achievements of the group (McNeal & Dwyer, 1999). A study by Ehrhard (2000) found no significant differences between the academic outcomes of students who had identified their learning styles and those who had not, although those who identified their own learning styles reported increased self-esteem and self-understanding. Coffield and colleagues (2004) concluded their review of Kolb's theory of experiential learning by saying although explicit and robust; it did not yet have a strong empirical base to support it.

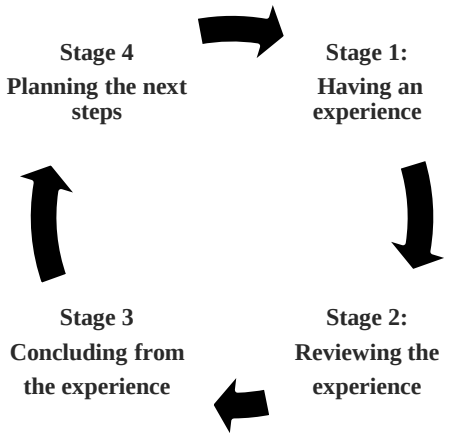
Studies that have used the LSQ have produced more positive, but also mixed results. For example, Honey and Mumford (1992, 2002) reported adequate test-retest reliability, claimed that the face validity of the LSQ is good, and have provided normative information for gender, geographical location and occupation. Other studies found that the temporal stability and internal consistency of the LSQ was satisfactory in comparison to similar learning styles instruments (Zwanenberg, Wilkinson, & Anderson, 2000). However, the concurrent and predictive validity of the LSQ were found to be not well established (Allinson & Hayes, 1990). Moreover, subsequent studies noted that the LSQ did not differentiate between the four learning styles to a sufficient degree (Swailes & Senior, 1999), and did not predict academic performance well (Dale, Price, Bishop, & Plomin, 2003; Duff & Duffy, 2002). The authors have responded by saying that the LSQ was not intended to be a psychometric instrument, but simply a checklist that invites people to consider how they learn from experience; more of a starting point for discussion between teachers and students (Coffield et al., 2004). It was for this reason that we began exploring the value of the LSQ as a measure of learning styles in clinical education. We felt that it might help supervising clinicians and students understand how they approach learning situations.

There is controversy in the literature as to whether learning styles are fixed traits or can be modified by experience and different learning methods. Those that hold that they are fixed maintain that learning styles are easily identifiable by instruments such as the LSQ (Coffield et al., 2004). Others argue that they are flexible and can be changed if learners are cognisant of their particular learning style and the strengths and weaknesses associated with it (Kolb, 2000). It is important to note that, although Kolb saw learning styles as having long term stability, he did not see them as fixed traits, but maintained that educational experiences could shape them and that styles may change depending on the situation (Kolb, 2000). Honey and Mumford (2000) also hold that learning styles are modifiable through different learning experiences. The current study adds to this area by

investigating learning styles with a group of students in a Problem-based Learning (PBL) curriculum and whether the styles would change over time with this new way of learning.

PBL is a method of integrated, student-centred learning that recognises that the goal of learning is to be able to apply knowledge in a sophisticated way to solve real-life problems efficiently (Fourie, 2008). Students work in small groups, setting their own learning goals by collaborating with each other in order to solve a 'problem' or trigger that is presented to them. The perceived advantage of a PBL curriculum is that it simulates actual clinical experiences, team working and social interaction thereby facilitating the development of skills needed for professional practice. As opposed to other methods of teaching, the learner is not a passive recipient of the lecturer's knowledge (Fourie, 2008) and so has to actively engage with the material. Another advantage is that the stages and activities involved in PBL map onto Kolb's learning cycle. Thus, by engaging in all of the stages involved in PBL, students can develop all of the four main learning styles (Kolb, 1984). This is illustrated in Fig. 6.1.

Fig. 6.1 Problem Based Learning and Kolb's Learning Cycle (*adapted from Kolb, 2000*)



At stage 1, students are confronted with a problem or a trigger. In clinical education, this is generally a patient's history, or data that the students need to explore. This corresponds with Kolb's stage of 'having an experience' and the preferences of the active learner. The structure of PBL forces learners to begin at this stage, where they are supposed to know little about the subject area, creating cognitive dissonance, an essential component of driving enquiry-led learning (Fourie, 2008). During this stage of PBL, a Chair encourages the group to brainstorm while keeping on task and a Secretary writes down key ideas, information and hypotheses from the group, which are based on any past experience or prior knowledge. Sugarman (1985) argued that teaching should always being with this stage of concrete experimentation, where personal experiences are considered. At this second stage, the group also generates *learning issues*, which are key questions that will form the basis for the next stage of the cycle, 'reviewing the experience'. This stage suits reflective learners, as students independently search the literature for possible answers to their learning issues. A few days later, the group meets to engage in the next stage of 'concluding from the experience', where students discuss the material they have found, aiming to draw relevant conclusions and reconsider their initial hypotheses. This involves forming abstract concepts, which is in line with the learning style of the theorist. The final stage of the PBL process matches the fourth stage of Kolb's learning cycle, where conclusions from the previous stage are translated into action. In PBL, this is when learning issues are answered or a product of learning such an information sheet or an academic journal is produced. The pragmatist prefers this stage, as it involves the practical application of information. Like the four stages in the learning cycle, the steps of the PBL process are mutually dependent, although time spent on each may vary considerably. Moreover, as Kolb maintained that students should become proficient at all four learning modes in order to become flexible learners (Coffield et al., 2004), the PBL process might also encourage students to develop all four learning styles.

Previous research related to the impact of PBL on learning styles is limited. Biggs (1987a; 1987b) used the Study Process Questionnaire (SPQ) to investigate the depth of learning achieved by a group of medical students who undertook a PBL course and found that they demonstrated deeper learning strategies than those who did not. Similarly, Mok, Dodd and Whitehill (2009) found that students exposed to PBL had a significant increase in their deep learning scores on the SPQ. However, Wun, Chan and Dickenson (1999) found no difference in deep learning scores on the SPQ between medical students who took part in a PBL module compared to their classmates who did not, although they were noted to make significant gains in their study skills. Baker, Pesut, McDaniel and Fisher (2007) used Kolb's LSI to evaluate the impact of PBL on the learning styles of nursing students. Although they found no significant change in any of the learning styles after two consecutive

semesters of PBL modules, there was a reduction in the number of students selecting the 'accommodator' learning style (similar to the 'activist' on the LSQ).

Duff and Duffy (2002) noted that students with a preference for a particular learning style could be expected to outperform those with preferences for other learning styles in certain learning environments. Honey and Mumford (2000) provided a list of activities that are thought to match each learning style and which might be linked to variability in performance in different teaching and learning situations. For example, activists prefer small group discussion and learning through practice; reflectors prefer lectures and independent research; theorists enjoy structured situations with clear objectives and being involved in discussions involving complex ideas and concepts while pragmatists like practical activities and practicing techniques under coaching from an expert. It may therefore be the case that different learners will perform better or worse depending on whether the learning environment matches their individual learning style. The empirical evidence for this is limited, although Furnham and Medhurst (1995) correlated learning styles on the LSQ with a range of academic outcomes and found a positive correlation between 'pragmatists' and their scores in university seminars.

Kolb maintained that identifying and appreciating different learning styles would help people to work more effectively in teams, to communicate and resolve conflict, improving success rates in learning (Coffield et al., 2004). This is presumably because students can understand the changes they need to make in their orientation to learning in order to suit how a subject is taught and teachers might be more empathetic to students who have difficulty with particular aspects of learning. As the LSQ has been found to have higher psychometric properties relative to other inventories, we used it to identify the learning styles of students entering a four-year PBL undergraduate speech and language therapy course and monitored their learning styles over a three-year period. We expected that the students, having come from a largely traditional, didactic teaching environment, would be predominantly reflective at the beginning of the year. As we considered PBL to address all four learning styles, we had no hypotheses as to which styles might change over time. However, because of the active nature of PBL tutorials and clinical placements, we did expect that students might show an increase in their active learning styles. Furthermore, as educational achievement is considered to be related to the learning opportunities provided, we were also interested in investigating whether there was an association between academic outcomes in the various courses taken by the students and their learning styles.

6.2 Method

6.2.1 PBL Curriculum

The Department of Speech and Hearing Sciences at University College Cork (UCC) was established in 2003 using a PBL-centred curriculum for the BSc (Hons) in Speech and Language Therapy. The curriculum was based on the University of Hong Kong curriculum, modified for the Irish context (Fourie, 2008) and is a 'hybrid' approach to PBL as students also attend traditional lectures and workshops for some modules. In UCC, the PBL sessions are structured in terms of an 11-stage process. These are:

1. Roles assigned to group members including a Chairperson to facilitate discussion and a Secretary to record information.
2. Problem presented and students define the content and identify key terms.
3. Students discuss what they know about the area from personal experience and prior knowledge.
4. Students hypothesise about the key features of the problem and justify their arguments.
5. Students identify questions or 'learning issues' for areas where they have insufficient knowledge.
6. Students are given references to key readings and divide the workload.
7. Students independently access books, journals and online resources.
8. Students reconvene to review learning issues and come up with key points.
9. Students reflect on what they have learned and develop a concept map or some other product of learning.
10. Students return to the problem and review the learning outcomes achieved.
11. Students reflect and evaluate their own and the group's performance.

The PBL curriculum centres on communication disorders in children and adults across years 1-3. Tutorial groups meet twice weekly for three-hour sessions. During this time students also attend other modules, most of which are integrated with the PBL topics of that particular week. These modules include anatomy, physiology, linguistics, speech and hearing sciences (instrumental and articulatory phonetics), research methods and clinical practice.

Over the four years, students are assessed in a variety of ways, from written assignments and essays, to oral examinations and presentations, class tests and exams. Clinical performance is assessed using an Irish competency-based instrument. The PBL curriculum is assessed through tutorial performance as rated by a tutor in each session and an academic reading form linked to the problem. Tutorial contributions are graded out of 100% for each tutorial based on a number of competencies such as the students' ability to ask questions, help the group solve conflicts and their knowledge of the prescribed readings, and averaged over the semester.

Reading forms are graded weekly, with feedback provided and involve the students completing a short essay applying relevant literature to the problem. The PBL module is also assessed through a written assignment and an open-book class test where students relate prescribed readings to a previously seen problem. There are two teaching semesters in the year (September to December and January to April) and in the 3rd semester students attend block clinical placements. For further information on the PBL curriculum in UCC, see Fourie (2008).

6.2.2 Participants

The participants consisted of an entire class of 30 undergraduate speech and language therapy students All were female, and had a mean age of 19.8 years at the beginning of the study. Five students were 'mature' (over 23) and no student had previous experience with PBL.

6.2.3 Measurement Instrument

The Learning Styles Questionnaire (LSQ; Honey & Mumford, 2000) was completed in a classroom situation by all participants and took between 10 and 15 minutes to complete. Students self-completed the questionnaire to determine their scores for each of the four learning styles. Students had a range of learning style preferences. In addition, they could identify the strength of their preference for each style, based on standardised measures provided on the LSQ, ranging from 'very strong 'to 'very low'.

6.2.4 Procedure

The students completed the questionnaire at five time points over a three-year period: at the beginning of their first year (Time 1), following the 1st semester (Time 2) and 2nd semester (Time 3) of their first year, at the end of their second year (Time 4) and at the end of their third year (Time 5). Four students left the course and one deferred at the end of 1st year so that 25 questionnaires were returned at the end of the 2nd year (Time 4). One student then had to repeat 2nd year so that at Time 5 there were 24 LSQs completed. A record of student marks for each module over the three years was also maintained.

6.3 Results

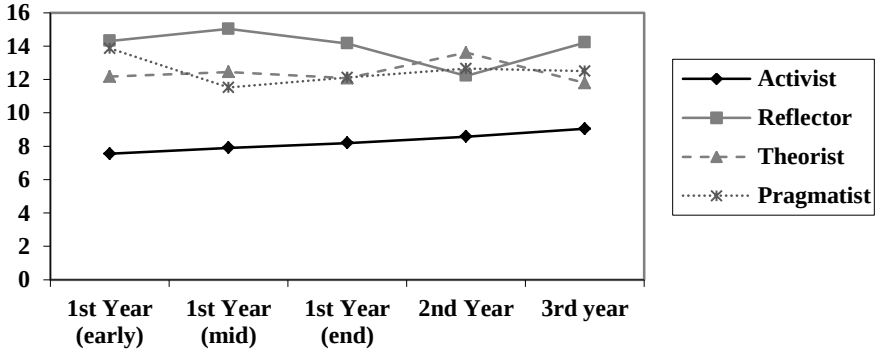
6.3.1 Change in Learning Styles

The scores that students received for each learning style (maximum = 20) were entered into an SPSS file (SPSS, 2004). In addition, the strength of their preferences was also analysed. Table 6.1 provides an overview of the mean and standard deviation scores for all learning styles assessed on the LSQ over the five time points; for ease of interpretation, the results are also represented graphically in Fig. 6.2.

Table 6.1 Mean and Standard Deviation results for learning styles over time

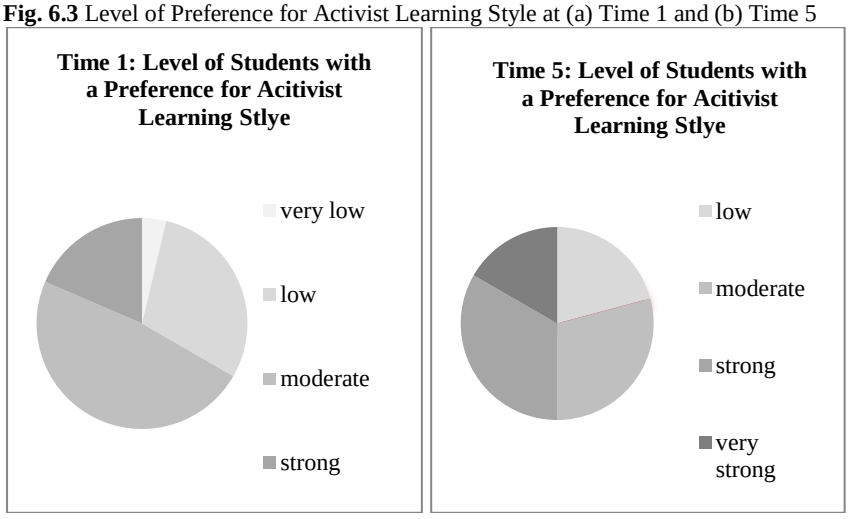
Time	**Reflector**		**Pragmatist**		**Theorist**		**Activist**	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
1	14.31	3.97	13.86	3.5	12.17	3.03	7.55	2.98
2	15.03	3.63	11.52	3.7	12.45	4.07	7.90	2.98
3	14.15	4.1	12.11	3.4	12.07	3.61	8.19	3.41
4	12.22	3.54	12.65	3.2	13.61	4.34	8.57	3.76
5	14.21	4.01	12.5	2.8	11.79	4.34	9.04	3.57

Fig. 6.2 Mean learning style scores (max=20) for group over time



Visually inspecting the data, students showed preferences for all four learning styles at the beginning of 1st year, although the lowest score was for activist. The students initially had a strong preference for both the pragmatist and reflector styles, although preference for the pragmatist style declined after one semester and then remained at a similar level over three years of the course. After one semester of PBL there was an increase in the scores for the reflector learning style, although this declined following the 2nd year, and increased again following the 3rd year. The theorist learning style remained relatively static over the three years, and scores on the activist style appeared to grow slowly. A mixed factorial ANOVA was carried out. The results indicated that there was a significant main effect of Learning Style, $F(1, 127) = 62.7$ $p \leq 0.001$. There was no significant effect for Time and no significant interaction. Post hoc analysis of learning styles showed that there was a significant difference between the activist learning style and the reflector, $t(131) = 10.87$, $p < 0.001$), the theorist, $t(131) = 8.05$, $p < 0.001$, and the pragmatist learning styles, $t(131)=9.76$, $p < 0.001$). Furthermore, there was a significant difference between the reflector learning style and the theorist, $t(131) = 4.56$, $p < 0.001$); and pragmatic learning style, $t(131) = 3.59$, $p < 0.001$). No significant difference was found between the reflector and pragmatist learning styles. Despite the lack of significant main effect for Time, we wanted to discover whether there was a significant change over time for any of the individual learning styles. Individual one-way Friedman's ANOVAs were carried out. The results indicated that the scores for both the reflector ($\chi^2(4) = 13.57$, $p \leq .01$) and the activist ($\chi^2(4) = 12.1$, $p \leq .01$) learning styles changed significantly over time. No significant change over time was found for the theorist or the pragmatist learning styles ($p > 0.05$). Visual inspection of the rankings in the reflector style indicated that there was an increase in the rankings from time 1 to time 2 (mean rank 2.94 to 3.72), followed by a sharp decline from time 3 to time 4 (mean rank 3.39 to 1.97) and a levelling off at time 5 with a mean rank of 2.97. On the other hand, the mean rankings for the activist learning styles increased in a gradual fashion from a mean rank of 2.33 at time 1 to a mean rank of 3.94 at time 5. Indeed, a Wilcoxon test revealed that this change from Time 1 to Time 5 was significant, $Z= 2.19$, $p < 0.05$. This change is also reflected in the increase in the number of 'strong' and 'very strong' preferences for the activist learning style over a three-year period from Time 1 to Time 5, as outlined in Fig. 6.3.

Fig. 6.3 Level of Preference for Activist Learning Style at (a) Time 1 and (b) Time 5



6.3.2 Learning Styles and Academic Outcomes

We then looked at student grades (out of 100%) in all subjects, and performed Spearman correlations to investigate whether there was an association between the scores received in a particular year and the various learning styles on the LSQ. Table 6.2 shows the associations. For 1st year, the questionnaire taken at Time 3 was used as a measure of the students' learning style, as this was the data collection time closest to when the final assessments took place.

Table 6.2 Spearman correlations between learning styles and subject grades

Subject *(Year)*	**Activist**	**Reflector**	**Theorist**	**Pragmatist**
Year 1 (n=30)				
PBL (1)	NS	NS	NS	NS
Linguistics (1)	NS	NS	-.39*	-.44*
Speech & Hearing Sciences (1)	NS	NS	NS	-.39*
Physiology (1)	NS	NS	NS	NS
Anatomy (1)	NS	NS	NS	NS
Final Marks Year 1	NS	NS	NS	-.43*
Year 2 (n=25)				
PBL (2)	NS	.46*	NS	NS
Linguistics (2)	NS	NS	-.51*	NS
Speech & Hearing Sciences	NS	NS	NS	NS
Anatomy (2)	NS	NS	NS	NS
Research Methods (2)	NS	NS	.-43*	NS
Clinical Practice (2)	NS	NS	-.57*	NS
Final Marks Year 2	NS	NS	-.63*	NS
Year 3 (n=24)				
PBL (3)	-.42*	NS	NS	NS
Linguistics (3)	NS	NS	NS	NS
Speech & Hearing Sciences (3)	NS	NS	NS	NS
Anatomy (3)	NS	NS	NS	NS
Research Methods (3)	NS	NS	NS	NS
Clinical Practice (3)	NS	NS	NS	NS
Final Marks Year 3	NS	NS	NS	NS

*NS- No significant correlations; * p≤.05*

In the 1st year of PBL, there was a significant negative correlation between pragmatist scores and results on linguistics (r = -0.44, p≤.05), speech and hearing sciences (r = -0.39, p≤.05) and the overall grade for the year (r = -0.43, p≤.05). There was also a negative correlation between theorist scores and grades in linguistics (r = -0.39, p≤.05). In the 2nd year, high scores for the theorist learning style had significantly negative associations with grades in linguistics (r = -.51, p≤.01), research methods (r = -.43, p≤.05), clinical practice (r = -.57, p≤.01), and the results overall (r = -.63, p≤.01). Moreover, there was a significantly positive association between scores for reflector and results in the PBL module in this year (r = .46, p≤.05). Finally, in the 3rd year, there was a significant negative association between scores on the activist learning style and results on the PBL module (r = -.42, p≤.05). No other significant correlations were found between grades and learning styles in this year.

6.4 Discussion

6.4.1 Changes in Learning Styles

The results demonstrated that the learning styles as measured by the LSQ remained relatively stable over the three-year period, which was in line with Kolb's predictions of stability in learning styles (Kolb, 2000). Price and Richardson (2003) and Kappe, Boekhold, den Rooyen and Van der Flier (2009) also found that, overall, learning styles remained stable over a two-year period when measured on the LSQ. In the current study, the students initially had a high score for the reflector learning style, and scores generally remained high for this learning style over the period studied. As reflectors are said to prefer activities where they have time to prepare and research background information before producing reports (Honey, 2002), and as this is represents much of the activity that happens during academic study, perhaps it is no surprise that students remained reflective learners over this period. However, we did find that as the students experienced a variety of learning environments and had an opportunity to develop all their learning styles, a gradual shift in their preferences was noted. For example, although the students initially received the lowest score for the activist learning style, following three years of PBL-based education their scores for this learning style increased and strengthened,. While this cannot be directly attributed to PBL, it is likely that the variety of learning opportunities offered in a clinically-oriented course, including clinical placements, are in line with the preferences of the active learner. Nonetheless, it is important to note that; overall, the students did not change their learning styles. It may be that developing an awareness of their learning style helps students to play to the strengths associated with it in order to overcome their weaknesses, and so their preference does not change. Indeed, Coffield and colleagues (2004)

argued that the metacognitive awareness that comes from knowing your own learning styles should promote more organised and effective learning strategies in students.

6.4.2 Association between Grades and Learning Styles

Analysing the association between academic grades and scores on the four learning styles, we found that in the first year, higher scores for the pragmatist learning style were correlated with lower results in linguistics, speech and hearing sciences and in the year overall. According to Honey and Mumford (1992), pragmatists are practical learners, and like to solve problems and see if theories and techniques work in practice. They are therefore technique-oriented but tend to reject anything without obvious application and so are not very interested in basic principles. This might explain the poor association with results in linguistics and phonetics, as pragmatists may not see the practical application of these subjects given that their clinical experience in this year is limited. Furnham and Medhurst (1995) found a positive association between pragmatists as measured on the LSQ and student performance in academic seminars in terms of students' grasp of the subject, motivation and written and oral expression. They attributed the association to that of 'performance' and with the fact that realism and innovation may help pragmatists to be highly rated in academic seminars. It may be that pragmatists need more of a practical environment in which to demonstrate their learning.

Furnham and Medhurst (1995) found a weak but positive negative association between theorists and their performance in academic seminars, which they attributed to their passive style of learning and the requirement of students to produce work. In the 2nd year, scores for the theorist learning style were negatively associated with outcomes in linguistics, research methods and clinical education, and with the results for the year overall. Theorists are described as logical, rationale, objective, and good at asking probing questions. They do however have a low tolerance for uncertainty, disorder and ambiguity and can be restricted in lateral thinking. Although they may be good at integrating observations into complex theories, they may have difficulty applying these to practice. This might explain the negative association with outcomes in clinical education, but not necessarily in linguistics, which could be argued to be more theoretically-oriented. However, the main assignment for the linguistics module in this year was to collect a language sample from a child and analyse it using a LARSP profile (Crystal, Fletcher, & Garman, 1989). In essence, this is a practical task of applying the profile to clinical data, and therefore may not be favoured by the theorist. Similarly, the research methods module was also essentially practical as it required carrying out statistical analysis on data, and so the practical orientation of the assessments in these modules might have contributed to the negative association with the theorist learning style in these modules and in the year overall.

In the 2nd year, there was also a moderately positive correlation (-0.46) between reflector scores and results in the PBL module. Furnahm and Medhurst (1995) also found a significant positive association between reflector scores and performance in academic seminar, and attributed this to the fact that reflectors were assiduous in attendance and essay contribution to the seminars. On the other hand, Furnham, Jackson and Miller (1999) found that the reflector style was negatively related to work performance. They hold that this was because reflectors tend to hold back from direct participation, are indecisive, risk averse and unassertive, which results in a poor performance in telesales. Similarly, reflectors might be characterised as liking to stand back and think about experiences in PBL, then collect data from all sources before coming to a conclusion. It is possible that because reflectors are good at listing to others and assimilating information, it helps their performance in PBL assessment. Furthermore, given that a substantial part of PBL is assessed through class tests and assignments it might not be surprising that scores for the reflector learning style were positively associated with outcomes in this module.

After three years of learning through PBL we found that, contrary to expectations, the scores for the activist learning style were negatively associated with grades in PBL (-0.42). Although we have argued that the different aspects of PBL suit all learning styles, we did expect scores for the activist learning style to have a positive association with results in this module due to the 'hands on' nature of the learning environment. However, no significant association was found. Similar results were found by Furnham and colleagues (1999) and Furnham and Medhurst (1995) between scores on the activist learning style and performance in telesales and academic seminars, respectively. The strengths of activists are that they are flexible, open-minded, and happy to try new experiences and be exposed to new situations. As previously mentioned, it was felt that the match between active learning style and an active learning environment such as PBL might be associated with enhanced performance in this module. However, previous studies have also confirmed that 'matching' the learning environment to the learning style does not necessarily result in higher academic outcomes. For example, Price and Richardson (2003) did not find that activists had higher academic performance in practical activities, such as work experience, compared to their peers with different learning styles. Similarly, Kappe and colleagues (2009) did not find increased grades when learning styles were matched to various learning environments including lectures, skills training, group projects, practical work and theses. Furthermore, as activists may have a tendency to rush into action without sufficient preparation and get bored with

implementation or consolidation, it may be that assessment methods such as academic reading forms, assignments and class tests do not 'match' the learning style of the activist, and so they perform poorly. Some argue that it is actually mismatching of teaching and learning styles that benefits the student more than matching, as it helps students to overcome weaknesses in their styles and become overall better learners (Dale et al., 2003). This would also explain the unexpected positive association between reflectors and their performance on the PBL module in the 2nd year.

6.5 Conclusions

One of the implications applications of Kolb's model of experiential learning is that instruction needs to be individualised. Although he acknowledges that this can be difficult with large group classes, he maintains it can be achieved through a change in the role of a teacher from a 'dispenser of information to a coach or manager of the learning process' (1984, p. 202). This very much mirrors the PBL approach to learning, where the tutor is considered to be a facilitator of student learning. Using Kolb's model of learning and the LSQ is a useful framework for students and tutors to consider when introducing PBL because it makes students aware of the learning cycle involved in PBL, and to the challenges and opportunities that will present themselves to the students during stages of the cycle, depending on their own learning preferences. Even though Duff and Duffy (2002) argue that the LSQ is not sufficiently sophisticated to describe the learning that takes place in higher education, it does provide a measure of learning styles that remains largely stable over time. In the current study, it also showed that certain learning styles were negatively associated with many of the practical subjects in clinical education of speech and language therapists, which would be useful to warn students about in advance, as they may have to put a greater effort into these particular subjects. Although this was a small-scale study and limited in the fact that we could not control for the teaching styles of teaching staff, we will continue to encourage students to identify their learning styles as it facilitates discussions between tutors and students and helps the students to identify their strengths and weaknesses. Future study might consider qualitative methods for exploring student perceptions of the benefits of knowing their learning styles and how this relates to their study methods and outcomes in PBL and other modules in clinical education.

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